

CLAIMS

1. A fuel cell assembly comprising:

5 a fuel cell stack having at least one inlet port for receiving cooling water and at least one outlet port for discharging water and / or water vapour, the inlet port and the outlet port each communicating with at least one membrane-electrode assembly of the fuel stack; and

10 a thermal storage tank having a heat exchanger conduit therethrough, the heat exchanger conduit having an inlet and an outlet coupled respectively to the at least one outlet port and the at least one inlet port of the fuel cell stack to form a cooling circuit for the fuel cell stack.

15 2. The fuel cell assembly of claim 1 further including a condensate collection unit in the cooling circuit between the heat exchanger outlet and the inlet port of the fuel cell stack.

20 3. The fuel cell assembly of claim 1 further including a water pump in the cooling circuit between the heat exchanger outlet and the inlet port of the fuel cell stack.

4. The fuel cell assembly of claim 1 in which the thermal storage tank includes a water jacket surrounding the heat exchanger conduit.

25 5. The fuel cell assembly of claim 4 in which the water jacket further includes a cold water feed and a hot water draw off point.

6. The fuel cell assembly of claim 4 or claim 5 further including an electrical heating element for heating the water jacket, the electrical heating element being coupled to an electrical output of the fuel cell stack.

7. The fuel cell assembly of claim 1 further including a pressure regulation means for controllably exhausting waste gases from the cooling circuit.
- 5 8. The fuel cell assembly of claim 1 in which the thermal storage tank includes a secondary water circuit passing therethrough for supplying a space heating radiator system.
9. The fuel cell assembly of claim 1 in which the inlet port of the fuel cell
10 stack receiving water from the cooling circuit is coupled to a direct water injection system of the anodes and / or cathodes in the fuel cell stack.
10. The fuel cell assembly of claim 1 in which the inlet port of the fuel cell
15 stack receiving water from the cooling circuit is coupled to provide preheat of fuel and / or oxidant supply to the respective anodes / cathodes.
11. The fuel cell assembly of claim 5 further including a valve coupled between the hot water draw off point and a waste water outlet, and a temperature sensor in the cooling circuit for actuating the valve when the water
20 in the cooling circuit exceeds a predetermined temperature.
12. The fuel cell assembly of claim 1 in which the at least one outlet port comprises a cathode exhaust port.
- 25 13. A method of operating a fuel cell assembly comprising the steps of:
feeding fuel and oxidant into a fuel cell stack to generate electrical current and water / water vapour by-product;
feeding the water / water vapour into a heat exchanger conduit of a thermal storage tank and extracting heat energy therefrom;

retrieving water and vapour condensate from the heat exchanger conduit and supplying it back to a membrane-electrode assembly in the fuel stack; and storing the thermal energy in the thermal storage tank, the fuel cell stack and heat exchanger conduit forming a water cooling
5 circuit.

14. The method of claim 13 further including collecting the retrieved water and vapour condensate in a condensate collection unit in the cooling circuit between the heat exchanger and an inlet port of the fuel cell stack.

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15. The method of claim 13 further including the step of storing the retrieved energy in a water jacket of a thermal storage tank.

16. The method of claim 15 further including the step of drawing off heated
15 water from the water jacket and replenishing with cold water.

17. The method of claim 13 further including the step of heating water in a second water circuit from the thermal storage tank.

20 18. The method of claim 13 further including the step of providing the retrieved water and vapour condensate as input to a direct water injection system of anodes and / or cathodes in the fuel cell stack.

25 19. The method of claim 13 further including the step of providing the retrieved water and water vapour condensate to the fuel cell stack for preheat of fuel and / or oxidant supply to the respective anodes / cathodes.

20. A fuel cell assembly substantially as described herein with reference to the accompanying drawings.

21. A method of operating a fuel cell assembly substantially as described herein with reference to the accompanying drawings.